99B-106

4.5 PSP Cover Sheet (Attach to the front of each proposal)

Proposal Title: East Delta Habitat Corridor (Georgiana Slough)
Applicant Name: Jeffrey A. Hart, Habitat Assessment & Restoration Team, Inc.
Mailing Address: 13737 Grand Island Rd. Walnut Grove CA 95690
Telephone: (916) 775-4021
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Amount of funding requested: $ 1,234,160 8K for 3 years

Indicate the Topic for which you are applying (check only one box).

- ☐ Fish Passage/Fish Screens
- ☑ Habitat Restoration
- ☐ Local Watershed Stewardship
- ☐ Water Quality
- ☐ Introduced Species
- ☐ Fish Management/Hatchery
- ☐ Environmental Education

Does the proposal address a specified Focused Action? ✓ yes _____ no

What county or counties is the project located in? Sacramento County

Indicate the geographic area of your proposal (check only one box):

- ☐ Sacramento River Mainstem
- ☐ Sacramento Trib: _____
- ☐ San Joaquin River Mainstem
- ☐ San Joaquin Trib: _____
- ☑ Delta: Georgiana Slough
- ☐ East Side Trib: _____
- ☐ Suisun Marsh and Bay
- ☐ North Bay/South Bay: _____
- ☐ Landscape (entire Bay-Delta watershed)
- ☐ Other: _____

Indicate the primary species which the proposal addresses (check all that apply):

- ☑ San Joaquin and East-side Delta tributaries fall-run chinook salmon
- ☐ Winter-run chinook salmon
- ☐ Late-fall run chinook salmon
- ☑ Delta smelt
- ☑ Splittail
- ☐ Green sturgeon
- ☐ Migratory birds
- ☐ Other: _____
- ☐ Spring-run chinook salmon
- ☐ Fall-run chinook salmon
- ☐ Longfin smelt
- ☑ Steelhead trout
- ☐ Striped bass
- ☐ All chinook species
- ☐ All anadromous salmonids

Specify the ERP strategic objective and target (s) that the project addresses. Include page numbers from January 1999 version of ERP Volume I and II:
ERP, Vol II, p. 112: "restoring tidal marsh will assist in the recovery of special status fish populations and provide high-quality aquatic habitat for other fish and wildlife dependent upon the Bay-Delta

Indicate the type of applicant (check only one box):

☐ State agency	☐ Federal agency
☐ Public/Non-profit joint venture	☐ Non-profit
☐ Local government/district	☑ Private party
☐ University	☐ Other: _____

Indicate the type of project (check only one box):

☐ Planning	☑ Implementation
☐ Monitoring	☐ Education
☐ Research	

By signing below, the applicant declares the following:

1.) The truthfulness of all representations in their proposal;

2.) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization); and

3.) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

Jeffrey A. Hart, HART, Inc.
Printed name of applicant

Jeffrey a. Hart
Signature of applicant

I-013750

FOCUSED ACTION:

East Delta Habitat Corridor (Georgiana Slough)

Tidal Marsh and Riparian Habitat Restoration

Applicant:

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13737 Grand Island Road
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Phone: (916) 775-4021
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Type of Organization: Private Corporation

Tax Identification Number: 94-3274391

EXECUTIVE SUMMARY

Project Description

Building upon work already in progress, this tidal marsh and riparian restoration project will substantially improve habitat conditions along more than 14 miles of Georgiana Slough. The specific restoration objectives for this important salmonid migration corridor are as follows:

1. Enhancement of approximately 7 miles of existing berms now vegetated with low quality scrub and/or weedy vegetation, with high quality climax riparian vegetation;
2. Restoration and enhancement of 3 miles of tidal freshwater marsh (tidal perennial aquatic) habitats with plantings on tidal flat berms;
3. Removal of exotic vegetation along the berm and embankment, and the replacement at these sites with native species;
4. Continuation of current and new bioengineering techniques for 3,000 linear feet of new areas, not covered by existing programs, on the Tyler Island side (Reclamation District 563) of Georgiana Slough;
5. Advancement of similar and possibly new bionengineering techniques on 5000 linear feet on the Andrus Island side of Georgiana Slough (Brannan - Andrus Levee Maintenance District, Reclamation District 556); and
6. Expansion of the research monitoring program already initiated on Tyler Island to new sites.

Much work has already been accomplished under an existing CALFED contract for Georgiana Slough, including geomorphic description, hydraulic analysis, vegetation mapping, aerial photography and GIS mapping, bioengineering design, restoration and monitoring plan, and the propagation of tens of thousands of plants native to the Delta. The extension of work already in progress and the addition of new restoration elements affords ideal opportunities for the application of *adaptive management* to this critical resource. The lessons and techniques learned in the earlier phases of the first implemented projects will be modified as necessary to ensure a greater degree of success in the later phases.

Location

Georgiana Slough is a 12 mile long waterway located immediately south of Walnut Grove, California within Sacramento County. The left or east bank is bordered by Tyler Island and is managed by Reclamation District 563; the right or west bank is bordered by Andrus Island and is managed by the Brannan - Andrus Levee Maintenance District, and Reclamation District 556 (Figure 1).

Biological/Ecological Objectives

The implementation of the plan addresses the CALFED primary objective of improving the restoration component of ecosystem function. The efforts of this project will substantially improve tidal marsh and riparian vegetation along this important habitat corridor. While this proposal falls under the category of habitat restoration and the *Focused Action* of East Delta Habitat Corridor (restoration of tidal marsh and riparian habitats along Georgiana Slough, page 20, PSP), its benefits are more far-reaching. Five of the six 1999 PSP funding priorities are

addressed: 1) recovery of at-risk native species; 2) the rehabilitation of natural processes in the Bay-Delta system; 3) the protection and restoration of functional habitat types for public values such as recreation, scientific research, and aesthetics; 4) prevention of the establishment and reduction of the negative impact of established non-native species; and 5) improvement of water quality.

Costs

Tables I and II outline the projected budget based on a 3-year program ($1,234,160) and the first year quarterly estimate and would include all aspects for environmental enhancement for more than 14 miles of Georgiana Slough.

Third Party Impacts

This project will have no known adverse or third party impacts. The local reclamation districts fully embrace both the levee protection component of this project and support the habitat improvements.

Applicant Qualifications

The Habitat Assessment and Restoration Team, Inc. (HART), is fully prepared to design and implement this project. Located on Steamboat Slough in the Delta, HART's 10-acre facility includes a plant nursery already stocked with native wetland plants, a potting barn and corporate yard, storage and tool sheds, several vehicles, an office with 4 computer workstations (including GIS and graphics capabilities), and considerable room for growth. Jeffrey A. Hart, Ph.D. of HART, Inc. has considerable experience in designing and implementing restoration projects in the Central Valley and the Delta. Well qualified subconsultants providing depth to the Team include: Tyson Holmes, Ph.D. (biologist, statistician); Inter-fluve, The Bioengineering Group, and Robin Sotir and Associates (all bioengineering firms); KSN, Robert Miller And Associates, and DCC Engineering Co., Inc. (all reclamation district engineers); Mitchell Swanson (Hydrologist). Qualified fisheries/invertebrate biologists will be recruited from UC Davis and/or Sacramento State University. Hart will be taking the State Contractors License exam on April 19, 1999.

Local Support/Coordination With Other Programs

This proposal has been submitted with full agreement and understanding from three Reclamation Districts that have jurisdiction for Georgiana Slough: Reclamation District 563 for Tyler Island, and Reclamation Districts 556 for the Brannan - Andrus Levee Maintenance District.

Compatibility With CALFED Objectives

In addition to the project's compatibility with CALFED biological and ecological objectives (as described earlier), this project is compatible with non-ecosystem CALFED objectives. First, the implementation of this proposal will lessen the chances of levee catastrophic failure by enhancing natural processes of bank protection afforded by natural vegetation. Second, dense habitat plantings will accelerate sediment deposition on bank and near-shore environments, thereby improving water quality.

PROJECT DESCRIPTION

Proposed Scope of Work

Background

Many of the older residents in the Delta remember when riparian vegetation along Georgiana Slough reached clear across the channel, forming a continuous overstory canopy from bank to bank. Much of this vegetation was removed for flood control during the late 1950's and early 1960's, which may have prompted further loss of vegetation through accelerated bank erosion because much bank now lay exposed to the tractive forces of currents and waves. In comparison to much of the heavily rock-revetted Delta waterways, Georgiana Slough still has moderately well-developed riparian vegetation, shaded riverine aquatic, and tidal freshwater marshes. However, a substantial need exists for the protection of this critical biotic resource and opportunities abound for the enhancement and restoration of the berm and near-shore environments. The emphasis of a currently funded CALFED project (Tyler Island Levee Protection and Habitat Restoration Plan, to HART, Inc.) is bank protection and habitat enhancement using bioengineering approaches on the Tyler Island side (Reclamation District 563) of the Slough. The first planning and design phase has been completed. Under the next implementation phase of this project, more than 2,000 feet of bank stabilization/habitat improvements will be implemented this summer and fall on Georgiana Slough, with another 3,000 feet on the North Fork Mokelumne River being implemented either in 1999 or 2000.

The proposed project builds upon work already completed for the Georgiana Slough, including geomorphic description, hydraulic analysis, vegetation mapping, aerial photography and GIS mapping, bioengineering design, restoration and monitoring plan, and the propagation of tens of thousands of plants native to the Delta. As per this proposal, the extension of this work already in progress and the addition of new restoration elements will create opportunities for the application of adaptive management to this critical resource.

Project Approach

This new proposal promises to accomplish the following objectives for habitat protection, enhancement, and restoration along Georgiana Slough:

1. Riparian Enhancement on Poorly Vegetated Berms. The berm is a shelf of elevated land between the water's edge and the toe of the levee. While in some locations the berm has been completely eroded to the base of the levee, a substantial berm measuring 20-30 feet exists on both banks for approximately 12.8 miles (Figures 2, 3). Presently, mature riparian vegetation is poorly developed for the majority of the berm (Figure 4). Most of the larger trees were removed years ago by the COE for "flood control." Most of the regrowth consists of dense shrubbery, including exotic stands of Himalaya blackberry (Rubus procerus) and giant reed (Arundo donax) (6). We propose planting approximately 7 miles of an enriched palette of riparian tree species, such as cottonwood, valley oak, live oak, sycamore, ash, boxelder, and species of willow on approximately 12 ft. centers. With time these plantings will diversify habitat conditions and provide a shaded canopy environment. Riparian habitats are among the most productive in California for wildlife, especially for many forms of Neotropical migrants and resident species. Riparian vegetation growing in near-shore environments provides shade and cover to many aquatic species, including threatened fishes. Planting of

these areas is necessary because the existing weeds prevent the natural recruitment of most riparian tree species. The design and implementation of this portion of the project will be developed in cooperation with the local reclamation districts.

2. Freshwater Marsh (Tidal Perennial Aquatic Habitat). Tidal freshwater marsh (or tidal perennial aquatic habitat) "consists of the estuary's edge waters, mudflats and other transitional areas between open-water habitats and wetlands" (ERP. Vol. I, p. 111), such as adjoining riparian habitats. Substantial opportunity exists for improvement of these tidal marsh environments, especially along the lower reaches of Georgiana Slough where higher width/depth ratios are associated with a wider depositional mudflat environment. A method successfully developed by HART is the ballast bucket planting method involving the use of organic, biodegradable buckets filled with an erosion-resistant soil mix and planted with typical wetland species. These buckets are placed within the mudflats or in riprap conditions. This method has proved successful on the North Fork Mokelumne River (on Tyler Island) and the Lower American River, in dynamic and hydraulically challenging environments (Figure 6). A diverse planting is proposed, including: bulrush (Scirpus acutis, S. californica, S. americanus), rush (Juncus effusus, J. balticus), sunflower (Helianthus californica), California hibiscus (Hibiscus lasiocarpus), and dogwood (Cornus sericea var. sericea). It is assumed that the restoration with these species, in variable spatial arrangements (clumping alternating with open mudflats), will result in greater habitat structural diversity, yielding improved aquatic habitat for macroinvertebrates and native fishes. An experimental design will be incorporated into the restoration plan that will test several hypotheses relating to plant species and structural diversity, and habitat value to native animal species.
3. Removal of Exotic Vegetation. We propose to simultaneously eradicate invasive weeds (Figure 5) and then replant with mature riparian plants species (especially trees, as mentioned above). The strategy for weed removal will involve: 1) cutting of stems followed by the application of herbicide; 2) replacement of exotic species with a native cover (such as sedge) that may out-compete the exotic species provided there is an initial maintenance program; and 3) eventually shading out of the sun-loving weeds through growth of the taller riparian tree species. This strategy of weed removal and replacement with native riparian trees has been met with approval by the local Reclamation Districts, whose flood control activities are hindered by the presence of these exotic species.
4. Bioengineering/Restoration: Tyler Island. Approximately 2,000 linear feet of bank erosion areas along the left bank (Tyler Island) has been identified for treatment under the present Georgiana I program. An additional 3,000 linear feet has been identified and is proposed for further treatment. The methods used will be based on the successes and/or failures of previous treatments (adaptive management) and new design concepts. To ensure that a diversity of design concepts are considered, HART will contract with other bioengineering firms, such as The Bioengineering Group and/or Robbin Sotir & Associates to assist in augmenting the palette of design concepts for bank stabilization treatment. This process will provide a means of peer review of current designs and, if needed, new design concepts. Some of these new techniques may include: crib walls, log revetment, and lunkers in steep bank environments; coir fabric over riprap to trap sediment; and other breakwater structures to dampen wave energies affecting bank stability. These techniques will be deployed at various locations on both banks of Georgiana Slough.
5. Bioengineering: Brannan - Andrus Island. HART, working with several other consulting firms, has developed a palette of bioengineering methods to arrest erosion and mass wasting

of shoreline environments and simultaneously protect existing habitat and create restored conditions. These methods include a combination of floating log breakwaters, brush boxes breakwater (Figure 7) and sediment trap structures, ballast buckets, coir biologs, and coir mattresses. Most of these methods are easily installed using hand labor and many of the materials are collected from Delta orchards. These treatment areas will be generously planted with sedges, rushes, bulrush, and woody plants such as alders, willows, cottonwoods, oaks, all collected from local genetic stock. The design of these techniques has been based on geomorphic and hydraulic analysis and experience from the use of these materials in similar environments. Their application to new areas along Georgiana Slough will be based on their degree of success under the current CALFED contract (adaptive management), and the confidence of the new measures proposed through the assistance of other bioengineering firms. Approximately 5,000 feet of bank protection is proposed for new treatment of the right bank of the slough.

6. Research Monitoring Program. The research monitoring program will include the testing of a variety of scientific hypotheses, including topical areas of interest such as erosion/deposition, boat-wake energies, instream shade, richness and biomass of aquatic macroinvertebrates, fish-species richness, and plant survival and cover between control and treated sites. The complete monitoring plan will consist of 6 components: 1) project goals and objectives, 2) statements of hypotheses, 3) sampling or censusing designs, 4) data management and quality control, 5) data-evaluation protocols, and 6) procedures for utilizing monitoring results in adaptive management of the project. Standard erosion pins will be used to measure erosion and/or deposition. Boat wakes will be monitored using pressure-transducers. Protocols for instream shade and aquatic fauna are under development. Proposed restoration and bioengineering sites will mapped and monitored using the ArcView GIS system. To date, a GIS data set for Georgiana Slough has been developed, consisting of new rectified aerial photography that has been incorporated with digital data from the COE for Georgiana Slough. Under this proposal, additional mapping will include new sites for bioengineering and habitat restoration.

Facilities and Equipment

This work will be implemented from HART's headquarters near Walnut Grove, which has full office facilities for project management, monitoring, data gathering and research; corporate yard for equipment storage and materials facilitation; and nursery for growing native plants used in the restoration of Georgiana Slough.

Tasks, Schedule, and Description of Deliverables

Table III includes a listing of the milestones, deliverables, consultant roles, and schedule of activities.

Location and Geographic Boundaries of the Project

Georgiana Slough is a 12 mile long waterway located immediately south of Walnut Grove, California in Sacramento County. The left or east bank is bordered by Tyler Island and is managed by Reclamation District 563; the right or west bank is bordered by Andrus Island and is managed by Georgiana slough: Brannon - Andrus Levee Maintenance District, and Reclamation Districts 317, 556, and 2067. The project site is located entirely within the Isleton 7.5 minute quadrangle.

ECOLOGICAL / BIOLOGICAL BENEFITS

Ecological/Biologcal Objectives

The implementation of this plan would address one of CALFED's primary objective for improving ecosystem function, specifically, habitat improvement. According to the 1999 Proposal Solicitation Package (PSP), this proposal would be included under the goal of Habitat Restoration (pages 15, 18), and the focused action of the East Delta Habitat Corridor (restoration of tidal marsh and riparian habitats along Georgiana Slough, page 20). Moreover, five of the six 1999 PSP funding priorities are also addressed: 1) recovery of at-risk native species, 2) the rehabilitation of natural processes in the Bay-Delta system, 3) the protection and restoration of functional habitat types for public values such as recreation, scientific research, and aesthetics; 4) prevention of the establishment and reduce the negative impact of established non-native species; and 5) the improvement of water quality.

Primary Ecological Objectives for this Project

The primary ecological objectives of this project are to: 1) enhance and restore 7 miles of riparian, shaded riverine aquatic habitat on berm environments along Georgiana Slough; 2) protect, enhance, and restore 3,000 linear feet of tidal perennial aquatic habitat along the near-shore tidal flats of Georgiana Slough; and 3) creat habitat along 8,000 linear feet of eroded embankment using bioengineering principals. The ecological benefits of these actions will be to: 1) increase shade and cover of near-shore and instream habitat conditions to the benefit of indigenous macroinvertebrates and fish species; and 2) increase the structural and biological diversity of these habitats to the benefit of terrestrial wildlife, such as riparian dependent avifaunal species.

Need for this Project

Georgiana Slough has been identified as one of the major migration corridors for salmon. As identified in the PSP (page 20), substantial losses to salmon occur in this area due to predation and entrainment. The creation and enhancement of riparian and tidal perennial aquatic habitat will enhance instream cover, hydraulic complexity, overhead shade and food, and macroinvertebrate food sources to the benefit of a number of at-risk species, including Delta smelt, Splittail, Chinook salmon, Steelhead trout, and Longfin smelt. Restoring Tidal Marsh Habitat will "assist in the recovery of special-status fish populations and provide high-quality aquatic habitat for other fish and wildlife dependent on the Bay-Delta." Restoring this habitat would result in higher water quality and increase the amount of shallow-water and mudflat habitats and provide rearing and foraging areas and escape cover for fishes (ERP, VOL. II, page 112). Near-shore riparian vegetation improves the foodweb and critical habitat for threatened and endangered species; stabilizes banks; benefits the aquatic environment by creating shade and reducing water temperature; and provides instream cover for fish, including juvenile salmonids. Very little mature riparian vegetation exists in the Delta, and tidal perennial aquatic habitat is equally diminished. It is well recognized that mature, multi-storied riparian vegetation provides critical habitat to many native species of wildlife, especially avifauna. The planting of climax riparian plants along the berms on both banks, and typical tidal marsh plants species in the instream environments along Georgiana Slough, will greatly improve habitat conditions along this important habitat corridor.

Comparison of Proposed Approach with Alternative Approaches

The techniques proposed in this proposal stand in contrast to historical efforts by the local reclamation districts and the COE which result in the application of rock revetment as the only solution to bank erosion. While rock revetment is a relatively straightforward method of bank protection, it has resulted in the loss of the vast majority of habitat in the Delta.

Stressors Addressed by this Project

This project combines the techniques and methods of habitat development with those of bioengineering. In doing so, a number of priority stressors to Georgiana Slough riparian and tidal marsh environments will be addressed including: 1) channel form changes induced by erosion, caused principally by boat wakes and river currents; 2) cumulative loss of riparian, shaded riverine aquatic, and tidal marsh environments due to erosion and previous levee management practices; and 3) loss of riverbanks and levees, which could increase the risk of catastrophic failure of Delta levees. A previous study conducted by HART's consultants indicated that boat wakes are a primary cause of the erosion, bank retreat, and habitat loss. The bioengineering and habitat restoration as proposed in this plan will alleviate some of the erosional problems and result in increased habitat values. An expanded research monitoring program will be applied to various environments to quantify the full effects of boat wakes and current forces.

Scientific Hypotheses to be Evaluated

Specific scientific hypotheses to be tested include the following: 1) centimeters of net deposition over the duration of the project will differ between do-nothing control sites and bioengineered surfaces; 2) on average during each boating season, wave energy as measured by wake gauges will differ between do-nothing control sites and bioengineered surfaces; 3) quantity of instream shade will be greater at planting sites compared to the do-nothing control sites; 4) quantity and biomass of aquatic invertebrate species will be greater at planting sites compared to the do-nothing control sites; 5) quantity of fish species will be greater at planting sites compared to the do-nothing control sites; 6) average vegetative cover will differ between the do-nothing control sites and the bioengineered sites; 7) plant-species richness and plant structural diversity will be greater at the restoration sites than at the do-nothing control sites; and 8) weed cover will be lower at the restoration sites than the do-nothing control sites.

Durability of the Project Benefits

The implementation of these strategies will result in a more durable environment. But since one of the primary stressors to the site — boat wakes — is a non-natural element, ongoing maintenance of the slough will likely be necessary. If the effect of the boat wakes could be reduced, then the restored sites would likely be self-sustaining.

Linkages

This project is an outgrowth of a current project funded by CALFED (to HART). Under the auspices of the Tyler Island Levee Protection and Habitat Restoration Plan, several goals have been accomplished: 1) geomorphic and hydraulic analysis of Georgiana Slough; 2) development of baseline GIS digital and airphoto coverage; 3) vegetation map using GIS technology; 4) map of primary bank types and erosion areas; 5) completion of a restoration and monitoring plan; 6) propagation of several tens of thousands of native wetland plant species from local Delta sources and the fabrication of bioengineering materials (brush cuttings for branch boxes). The proposed project would build upon this ongoing work by: 1) applying similar and

possibly new techniques to new areas on Tyler Island and the Brannon - Andrus Island side of Georgiana Slough; 2) restoring intact berms on both sides with a more fully developed palette of riparian species; 3) increasing instream tidal marsh habitat; 4) vegetating riprap sites; 5) removing exotic vegetation; and 6) expanding existing monitoring efforts to the new sites addressed by this proposal (in order to establish more complete monitoring of the effect of boat wakes on bank erosioin and habitat conditions along Georgiana Slough).

This program will aid in achieving other CALFED 1999 PSP objectives, such as Goal 1 (Native Species Recovery and Conservation), by providing shaded riverine aquatic and tidal freshwater wetlands; Goal 2 (Rehabilitation and Protection of Natural Processes), by protecting existing soft bank habitats with bioengineered breakwater structures and the assessment of the effect of boat wakes on natural processes of sediment transport; Goal 5 (Introduced Species) by the systematic removal of invasive species such as himalya blackberry and giant reed and the replacement with native species; and Goal 6 (Water Quality), through bank protection measures that arrest erosion and enhance sediment deposition.

System-Wide Ecosystem Benefits

The implementation of this project will have system-wide benefits to fisheries since Georgiana Slough is a primary corridor for fish migration between the Delta and the upper Sacramento River watershed. Georgiana Slough is also central to discussions regarding water conveyance through the Delta. Measures that help protect these resources will benefit overall CALFED planning efforts.

Compatibility with Non-Ecosystem Objectives

There are no known conflicts with other CALFED objectives. Other goals for this project are compatible with other non-ecosystem objectives. Habitat protection, enhancement, and restoration along the near-shore, bank environment will occur through a variety of bioengineered structures and plant installations that will further the protection of banks and levees from catastrophic failure by enhancing natural processes of bank protection afforded by natural vegetation. Dense habitat plantings will accelerate sediment deposition on bank and near-shore environments, thereby improving water quality. The systematic removal of exotic species such as giant reed (Arundo donax) and Himalaya blackberry (Rubus procerus) and replanting with native species will measurably improve the aesthetics of the Delta for the recreational public.

TECHNICAL FEASIBILITY AND TIMING

Other approaches that have usually been applied to Georgiana Slough and elsewhere include the use of riprap and stone-peaked dikes. Most of the Delta has already been extensively treated with riprap, to the detriment of natural, soft riverbank environments. Peaked stone dikes have been successfully applied to several areas in the Delta, but these structures also result in loss of natural environmental features. Some of the techniques proposed in this plan (e.g., ballast buckets) have already been successfully applied in the Delta.

Using the efforts of the Tyler Island Levee Protection and Habitat Restoration Plan as a guide, several regulatory and planning issues need resolution before work would begin. A Nationwide Permit Number 13 (NW-13) will be the appropriate permitting mechanism to satisfy 401 water quality certification. NW-13 regulates the discharge of dredged or filled material into waters of the United States for bank stabilization activities necessary for erosion prevention. It

requires notification of the Corps if the proposed project exceeds 500 feet in length or averages greater than 1 cubic yard of fill material per linear foot of shoreline. Because the project involves the establishment of native plant material and the placement of biotechnical erosion control below the mean high tide level, the NW-13 will be sought. A general condition (#9) of the NW-13 requires state water quality certification from the Regional Water Quality Board. A Department of Fish and Game Streambed Alteration Agreement will also be sought. Because this project is considered to be part of ongoing maintenance, it has been determined that this type of project qualifies for categorical exemption under CEQA, the precedent of which was established by Reclamation District No. 563 for similar work at Tyler Island. The only serious constraint to the implementation of this type of project is the restriction of working in the water only between August 1 and November 30. HART is currently seeking a waiver of that condition.

MONITORING AND DATA COLLECTION METHODOLOGY

Biological and Ecological Objectives

Table IV outlines monitoring objectives, data collection and evaluation procedures. Monitoring objectives are: 1) to document the relationship between plant/bioengineering installations relative to control sites to determine the extent of sediment recruitment and erosion; 2) to assess the energy forces of waves and current in relationship to control sites and habitat sites; 3) to document the increase of habitat structural and species diversity of instream and nearshore wetland environments especially in relationship to increases of macroinvertebrates and fishes 4) to document increase of habitat structural and species diversity of theterrestrial riparian habitat; and 5) to reduce weed populations. All monitoring should continue for several years past project completion. However, some of the monitoring objectives (#'s 1, 2, 3, 5) will be accomplished during the contract period of the project while others (#4) can best be measured after habitat is well-developed. Specific hypotheses to be addressed include: 1) centimeters of net deposition over the duration of the project will differ between do-nothing control sites and bioengineered surfaces; 2) on average during each boating season, wave energy as measured by wake gauges will differ between do-nothing control sites and bioengineered surfaces; 3) quantity of instream shade, cover and structure will be greater at planting sites compared to the do-nothing control sites; 4) quantity and biomass of aquatic invertebrate species will be greater at planting sites compared to the do-nothing control sites; 5) quantity of fish species will be greater at planting sites compared to the do-nothing control sites; 6) average vegetative cover will differ between the do-nothing control sites and the bioengineered sites; 7) plant-species richness and plant structural diversity will be greater at the restoration sites than at the do-nothing control sites; and 8) weed cover will be lower at the restoration sites than the do-nothing control sites.

Monitoring Parameters and Data Collection Approach

Sediment deposition and/or erosion will be compared between bioengineered and control sites by installing metal erosion pins. Measurements will be made at the end of the depositional season (end of winter) and at the end of the boating season (September). Mobile arrays of pressure transducers will be employed to compare wave energies between bioengineered and control sites. Monitoring of plant installations will initially consist of survival censuses and later of cover sampling. Aquatic macroinvertebrate, fish, and instream shade monitoring will be

accomplished through recruiting a student research program at UC Davis and/or Sacramento State Universiy. Monitoring for all parameters, with appropriate modifications, will follow the sampling and census designs developed for current work on Georgiana Slough. Access to sites will be from both land and survey boats.

Data Evaluation Approach

The bioengineered sites will include enough replicatated treatment and controls to permit statistical conclusions to be drawn about the relative merit of different methods. The different sites will first be classified using ordination or clustering techniques using various factors such as reach characteristics and morphology of the particular sites. Data collected will consist of centers of sediment gain or bank loss. Results from the experiment will be analyzed via an appropriate two-factor ANOVA or related techniques. Data for tidal marsh and instream cover will be measured using habitat complexity models, species presence, including population estimates, for macroinvertebratres and/or fish.

LOCAL INVOLVEMENT

The Delta Commission and the Sacramento County Planning Department have been notified of this project. This proposal has been submitted with full agreement and understanding from three Reclamation Districts that have jurisdiction for Georgiana slough: Brannon - Andrus Levee Maintenance District, Reclamation Districts 317, 556, and 2067. The funding of this project to the Habitat Assessment and Restoration Team would provide support to Delta based industries, thereby fostering the local economy.

COST

Budget

Table I outlines the projected budget based on a 3-year program ($1,234,160) and Table II divides this into a quarterly budget for the first year ($402,902). This budget would include all planning, permitting, plan development, plant progagation, riparian restoration, tidal marsh restoration, bioengineering, construction management, monitoring and mapping, and project management for more than 14 miles of slough enhancement.

Schedule

Table III outlines the schedule of milestones, consultant roles, and deliverables.

APPLICANT QUALIFICATIONS

This project will be delivered by the Habitat Assessment & Restoration Team, Inc. (HART, Inc.), located near Walnut Grove, CA. HART specializes in natural resource surveys and habitat analyses, restoration design, nursery growing of native wetland plants, and restoration implementation. Located along Steamboat Slough on Grand Island (in the Delta), HART's 10-acre facility includes a plant nursery stocked with native wetland and riparian plants, a potting barn and storage and tool sheds, several vehicles, office facilities including 4 computer workstations with GIS and graphics capabilities, and considerable room for growth. Jeffrey A. Hart, Ph.D., will serve as overall project manager. Dr. Hart has had considerable success in designing and implementing restoration projects (e.g., Stone Lakes National Wildlife Refuge), bioengineering projects (e.g., Dry Creek, Lower American River, North Fork of the Mokelumne River), and resource studies (e.g., Consumnes River, Lower American River). His clients include mostly government agencies and non-profit companies such as the Sacramento Area Flood Control Agency, California Department of Water Resources, Turlock Irrigation District, Sacramento County Water Resources Division, Ducks Unlimited, and The Nature Conservancy. Hart has successfully completed restoration contracts with Ducks Unlimited (contact Jim Well, phone 852-2000). Since moving to Grand Island in July, 1998, HART has successfully established a native plant nursery where considerable quantities of native plants are already under propagation. Many of the tasks for the project will be performed by Jeff Hart and his employees. Other tasks will be performed by the following subcontractors:

Tyson Holmes, PhD. Tyson Holmes will provide consultation in monitoring design to this project. He has developed sampling, monitoring, and experimental designs and conducted statistical analyses for restoration projects and ecological research in oak woodlands, riparian corridors, vernal pools, grasslands, wetlands, riverine aquatic-plant habitat, marshlands, and dune systems. He consults to private non-profits, private consulting firms, and universities as well as municipal, regional, State, and Federal agencies.

Mitchell Swanson and Associates. Mitchel Swanson and Associates, located in Santa Cruz, specializes in geomorphic and hydrologic analyses. They will be responsible for the monitoring of wave energies.

The Bioengineering Group, Inc. (TBG). TBG will provide design consulting services. This firm has considerable expertise in the use of vegetation for construction projects designed to optimize environmental benefits. Its staff, which combines expertise in the fields of aquatic biology, ecology, and water quality; hydrology, fluvial geomorphology, and hydraulic engineering; and native plant horticulture, soil science, and wetland management, provides a full range of consulting services in the field of bioengineering.

Robbin B. Sotir & Associates. Robbin Sotir & Associates, a leading firm specializing in soil bioengineering, will also will provide design consulting services. This firm has expertise in site reconnaissance and analysis and design for biotechnical slope protection. It will be used primarily for development of designs and specifications.

Inter-Fluve. This firm will provide construction oversight. Founded in 1983, Inter-Fluve is a 24-person water resource consulting firm that specializes in stream, river and wetland design and construction. They have completed over 400 restoration projects nationally. Their technical

staff, composed of plant ecologists, fisheries biologists, hydrologists, geomorphologists, hydraulic engineers, CADD technicians and construction managers, have broad backgrounds in fluvial processes, river mechanics and water resource management. Inter-Fluve also offers a wide range of project experience in the region dealing with channel repair and streambank bioengineering.

Kjeldsen, Sinnock & Neudeck, Inc. (KSN). KSN will provide survey, mapping, and planning functions. This firm is a full service civil engineering and land surveying firm specializing in the surveying, mapping, planning, design and construction of municipal, public works and water resources related projects. The firm currently serves as consultants to over thirty communities, special districts, and local public agencies in the San Joaquin County and foothill areas. The firm presently maintains a highly qualified staff of over twenty, which includes civil engineers, land surveyors, a landscape architect, engineering and CADD technicians, field inspectors and additional administrative support staff.

Robert Miller & Associates and DCC Engineering Co, Inc. are two engineering firms who consultant with Reclamation districts on Georgiana Slough. They will assist in policy, planning, and design issues.

Keith Whitener, a fisheries biologist, will work in conjunction with UC Davis (Dr. Peter Moyle's lab) and Chuck Hansen to conduct fish and aquatic invertebrate surveys.

COMPLIANCE WITH STANDARD TERMS AND CONDITIONS

The applicant will comply with standard terms and conditions, including Attachment D, Table D-1, and Attachments E, in the PSP.

Table I. Total Budget

Task	Direct Labor Hours	Direct Salary & Benefits (hourly)	Service Contracts		Material & Acquisition Costs	Misc. & other Direct Costs	Overhead & Indirect Costs	Total Costs
1. Planning and Permitting	50	$90						4,500
	50		(Davis)	$70				3,500
	50		(KSN,Miller,GBC)	$100				5,000
2. Restoration and Monitoring Plan	250	$90						22,500
	100	$50						5,000
	80		(TBG,Soltir)	$100				8,000
	80		(Fish/invertebrates)	$80				6,400
3. Plant Propagation						6,000 plants @$4.00 ea		24,000
						30,000 plants @1.00 ea		30,000
						5,280 plants @$7.00 ea		36,960
4. Riparian Restoration	5000	$35						175,000
5. Tidal Marsh Restoration	8000	$35						280,000
6. Bioengineering	8,000	$35						280,000
7. Miscellaneous Materials/Equipment					125,000			75,000
8. Construction Management	80		(Inter-Fluve)	$80				6,400
9. Monitoring & Mapping	200	$90						18,000
	450	$50						22,500
	80		(Holmes)	$80				6,400
	200		(Aquatic consultant)	$80				16,000
	311		(Swanson)	$90				28,000
10. Project Management/ Administration	9002	$90						81,000
	1000	$50						50,000
							TOTAL	**$1,234,160**

Table II. Quarterly Budget

Task	Quarterly Budget Oct-Dec 99	Quarterly Budget Jan-Mar 0	Quarterly Budget Apr-Jun 00	Quarterly Budget Jul-Sept 00	Quarterly Budget Oct-Dec 00	Total Budget
1	$8,000	5,000	0	0	0	$13,000
2	15,000	20,900	6,000	0	0	41,900
3	0	$30,000	$5,000	$5,000	0	40,000
4	0	0	0	0	$30,000	30,000
5	0	0	0	50,000	50,000	100,000
6	0	0	0	40,000	40,000	80,000
7	6,000	6,000	6,000	6,000	6,000	30,000
8	0	0	0	1,500	1,500	3,000
9	0	0	10,000	10,000	0	20,000
10	9,000	9,000	9,000	9,000	9,000	45,000
					TOTAL	**$402,902**

Table III. Schedule

Milestone	Consultant	Deliverables	Time
Survey/classification of sites	HART*., Interfluve	GIS map /written description	Fall, 1999
Planning/permitting	Davis, HART	Permits secured	Fall, 1999
Design/restoration & monitoring plan	HART, Sotir, TBG, Holmes, Swanson & others	Restoration & Monitoring Plan	Spring, 2000
Growing of plants, materials fabrication	HART, Inc.	Number of plants propagated/ materials constructed	1999-2002
Implementation	HART, Interfluve	Quarterly Reports of amount of habitat installed	Summer -Fall, 2000-2002
Monitoring	HART, Holmes, Swanson, UC Davis	Monitoring reports	Per CALFED quarterly reports
Project Management	HART	Reports, implementation, etc.	1999-2002

Table IV. Monitoring and Data Collection Information

Biological/Ecological Objectives		
Hypothesis /Question to be Evaluated	Monitoring Parameters & Data Collection Approach	Data Evaluation Approach
1. Centimeters of net deposition over the duration of the project will differ between do-nothing control sites and bioengineered surfaces	Use of erosion pins, placed randomly within geomorphic subdivisions of each scallop to measure net deposition	Analysis of variance comparing control sites with treatment sites
2. Wave energy as measured by wake gauges (pressure transducers) will differ between do-nothing control sites and bioengineered surfaces	Descriptive of comparative energy forces using pressure transducers	Analysis of variance
3. Quantity of instream shade, cover and structure will be greater at planting sites compared to the do-nothing control sites	Percent shade and vegetative cover present	Percent increase in shade and cover over time.
4. Quantity and biomass of aquatic invertebrate species will be greater at planting sites compared to the do-nothing control sites	Population sample	Comparative difference in numbers and biomass, using appropriate statistical measures
5. Quantity of fish species will be greater at restored sites compared to control sites	Population sample	Comparative difference in numbers and biomass, using appropriate statistical measures
6. Average vegetative cover will differ between the do-nothing control sites and the bioengineered sites	Percent cover, using photodocumentation and/or line intercept methods	Percent vegetative cover increased
7. Plant-species richness and plant structural diversity will be greater at the restoration sites than at the do-nothing control sites	Species numbers and abundance relative to different different canopy layers	Diversity indices/ physical habitat model
8. Weed cover will be lower at the restoration sites than the do-nothing control sites	Percent vegetative cover measured	Percent vegetative cover decreased

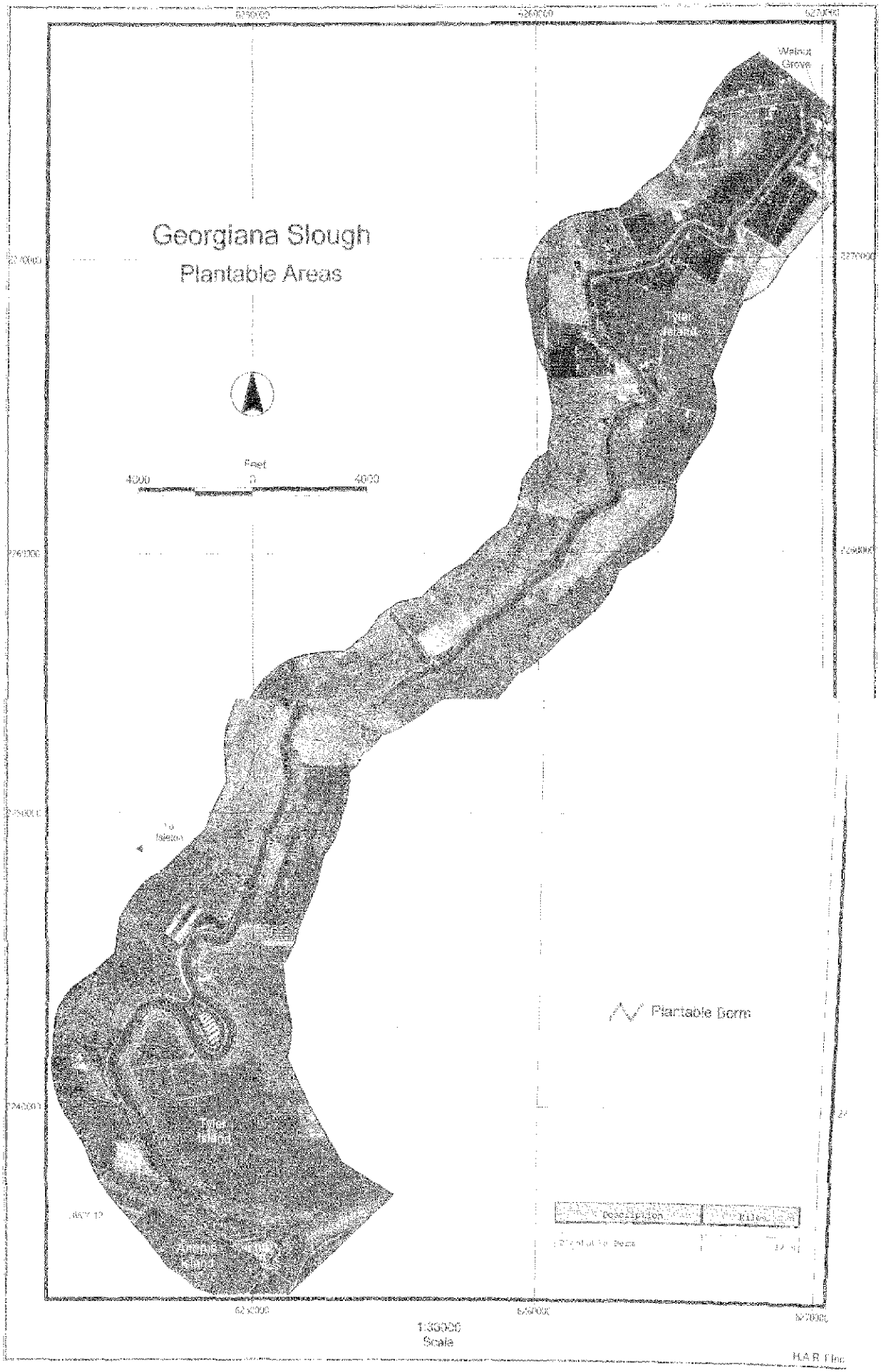
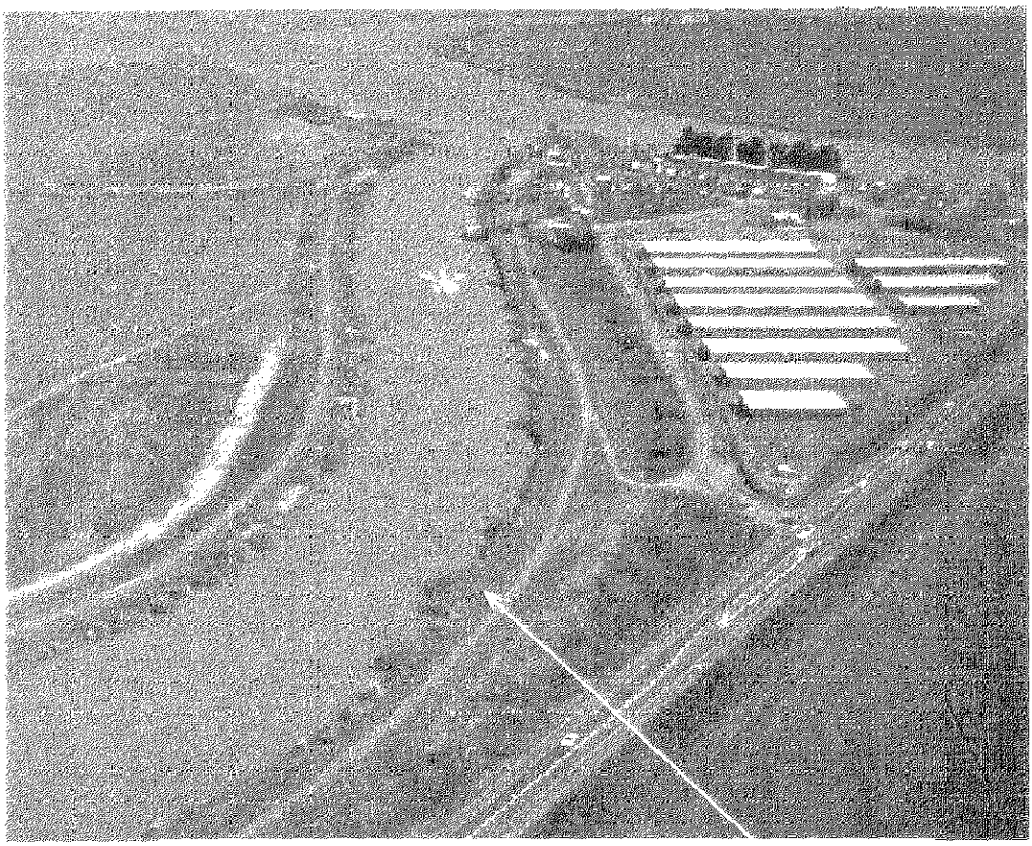
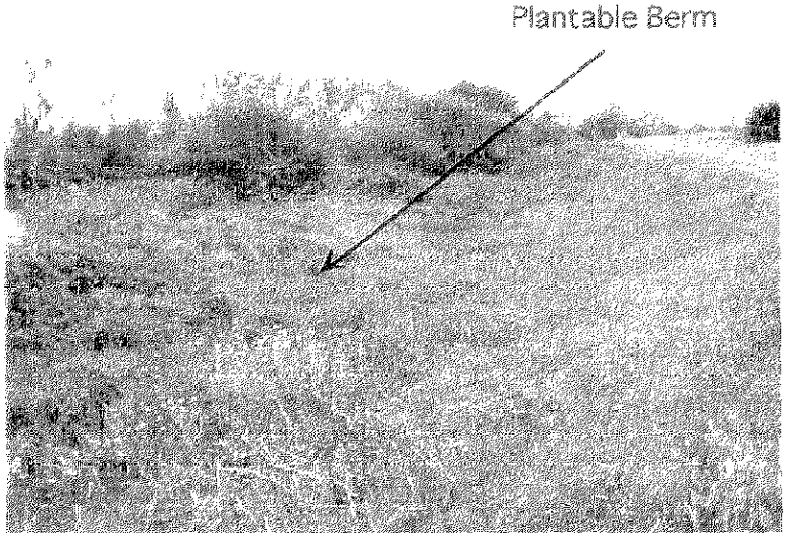


Figure 2

I-013768

East Delta Habitat Corridor (Georgiana Slough)





Figures 3A and 3B. Above photo: Lower end of Georgiana Slough at confluence with Mokelumne River. Note lack of vegetation and plantable berm surface. Below photo: close up of plantable berm surface.

East Delta Habitat Corridor (Georgiana Slough)

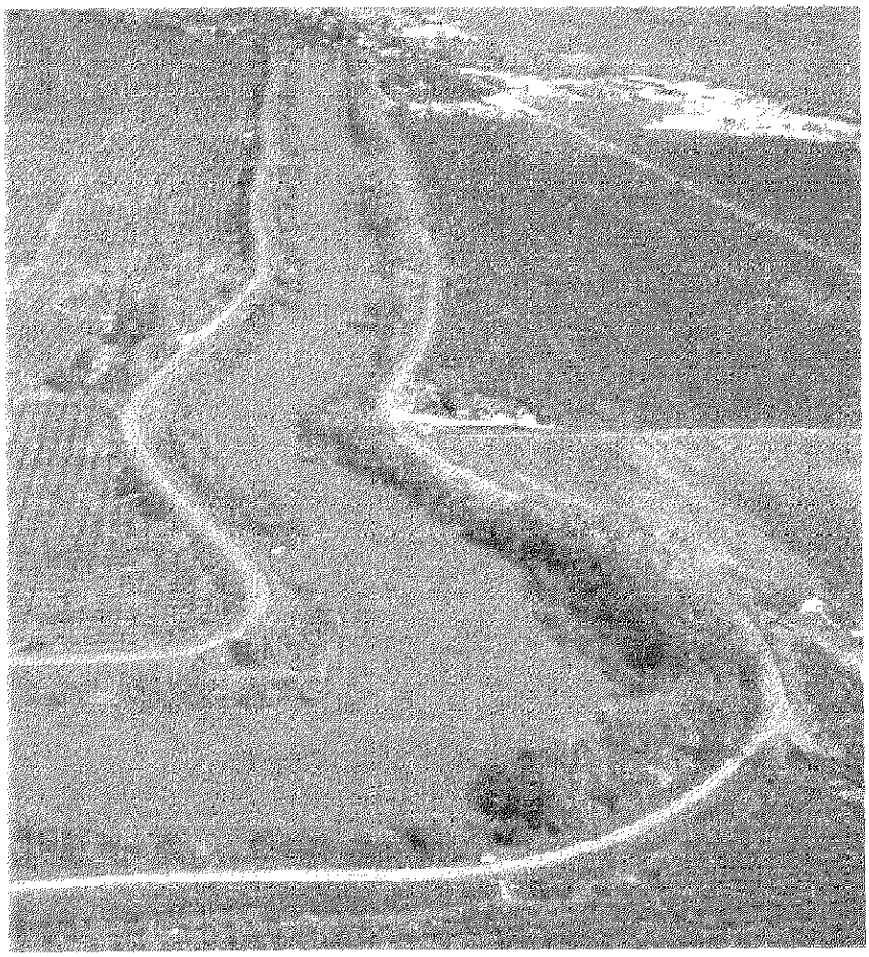


Figure 4A.

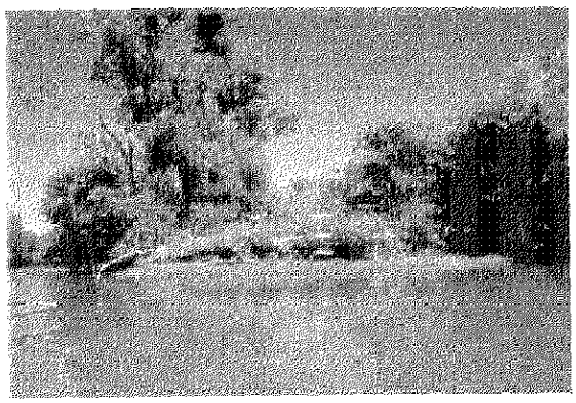


Figure 4B.

Mature riparian vegetation.

Figure 5A. Himalaya blackberry

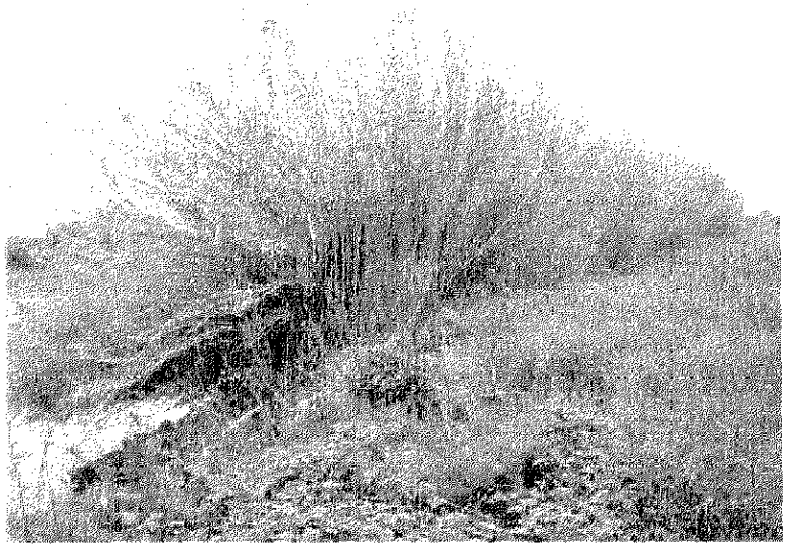


Figure 5B. Giant reed

East Delta Habitat Corridor (Georgiana Slough)

Ballast Buckets Preparation

Some plants , having their roots entwining a rock and soil matrix, are able to grow in hydraulically challenging riverine environments. To mimic these successfully established plants, a new technique called "ballast buckets" has been invented by H.A.R.T. This involves the use of a mixture of scoria lava rock, soil, and plant material in biodegradable, organic buckets.

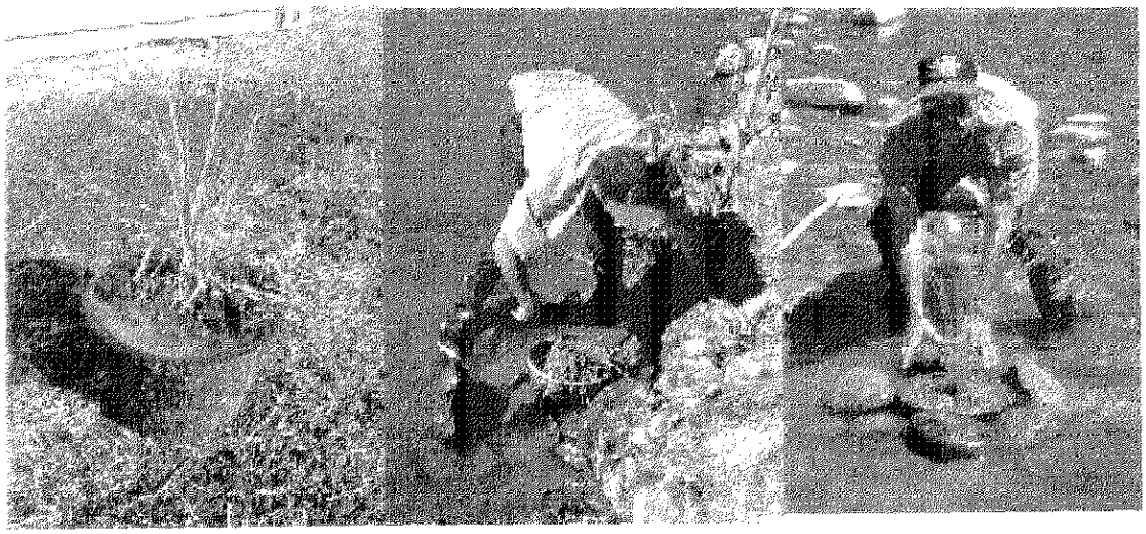
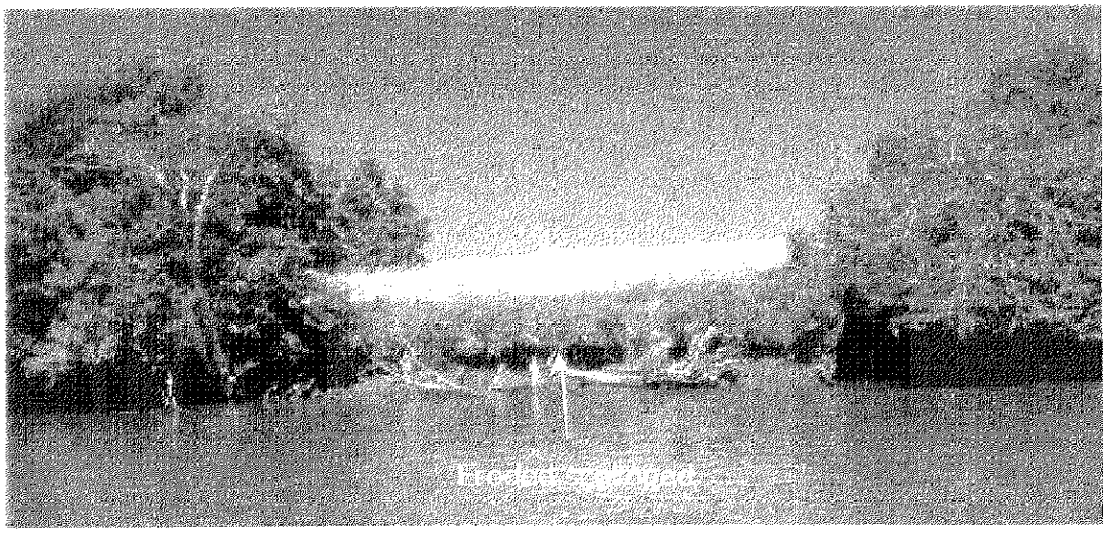


Figure 6.

Ballast buckets can be planted in various mixtures of rock, either in the water or at the water's edge. Their initial weight anchors the plants, thus facilitating survival under extreme current flow. The roots will gradually grow out from the decaying bucket, thus further anchoring the plant to the substrate. These techniques will be used on both the Mokelumne River and Georgiana Slough portions of Tyler Island.

East Delta Habitat Corridor (Georgiana Slough)



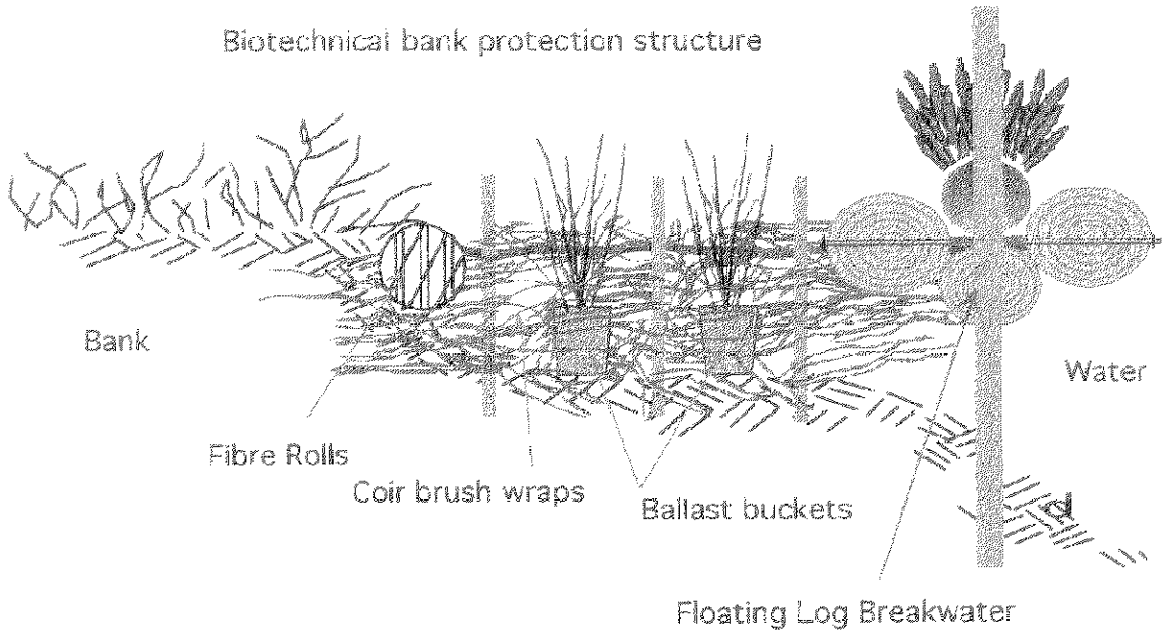


Figure 7.

Typical eroded scallop on Georgiana Slough. To arrest further erosion and to restore the site to improved habitat conditions, a variety of biotechnical structures and installed plants will be deployed to dampen wave and current energies(floating log breakwater structures and brush boxes,), capture sediment (fibre rolls), stabilize the toe of the levee slope (fibre rolls), and provide a wave and current resistant planting structure (ballast bucket)

HART Inc.
Habitat Assessment
& Restoration Team

April 13, 1999

Sacramento County Board of Supervisors
700 H. Street, Suite 304
Sacramento, CA 95814

To Whom It May Concern:

This is to notify the Sacramento County Board of Supervisors that the Habitat Assessment & Restoration Team, Inc. is submitting a CALFED proposal for funds to enhance riparian and tidal marsh habitat and provide levee protection along Georgiana Slough, located immediately south of Walnut Grove, in Sacramento County. I am sending you a preliminary copy of the executive summary that will acquaint you with our proposed project.

Sincerely,

Jeffrey A. Hart

Jeffrey A. Hart

13737 Grand Island Road
Walnut Grove, CA 95690
phone: 916/775-4021
fax: 916/775-4022

April 13, 1999

Sacramento County Planning Department
827 7th Street
Sacramento, CA 95814

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H.A.R.T. Inc.
Habitat Assessment
& Restoration Team

April 13, 1999

Delta Protection Commission
14215 River Road
P.O. Box 530
Walnut Grove, CA 95690

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